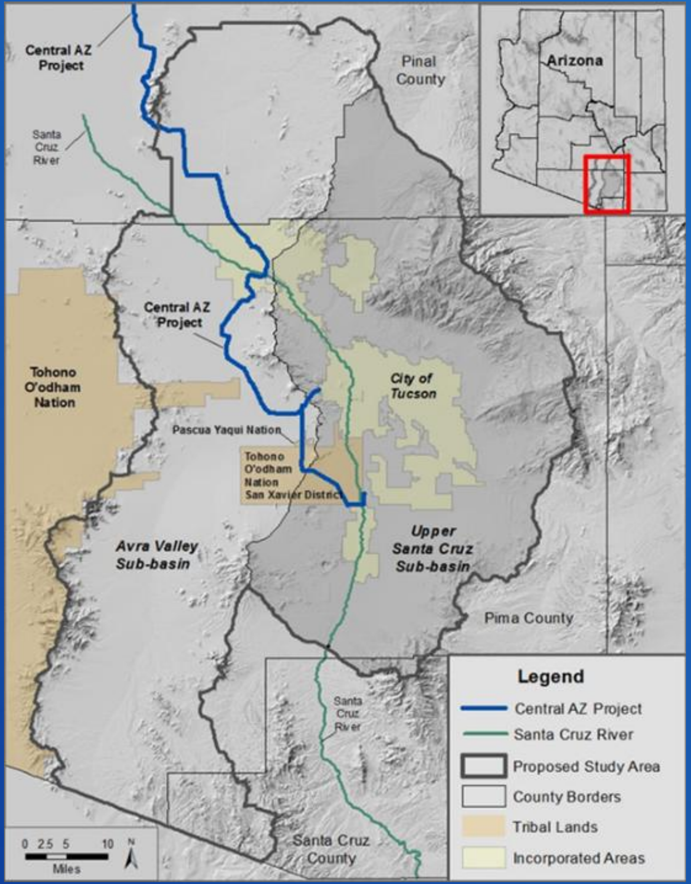
Lower Santa Cruz River Basin Study:

Study Process Overview and Role of Stakeholder Advisors

Eve Halper,
Natural Resources Specialist
Bureau of Reclamation
Stakeholder Advisors Meeting
April 24, 2017



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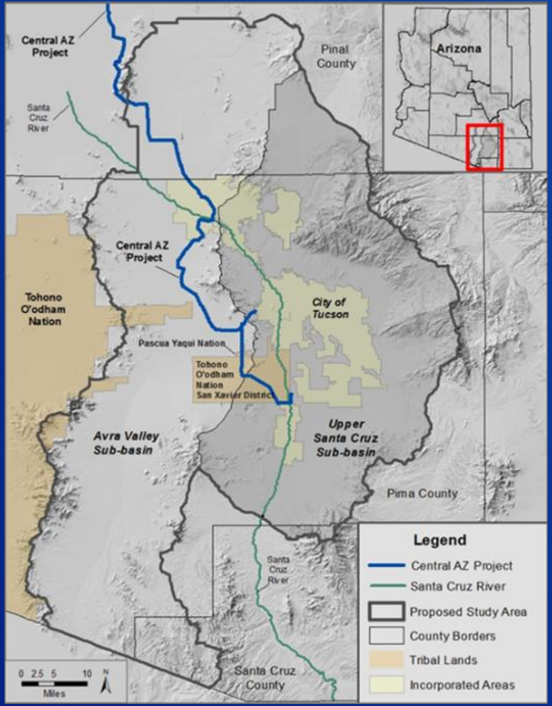
Lower Santa Cruz River (LSCR) Basin Study Summary



- Addresses the impacts of changing climate, population and other factors on water use through 2060
- Focuses on spatial distribution of water resources in the Tucson basin (Tucson Active Management Area)
- Includes analysis of environment (riparian areas)
- Employs a scenario approach to explore range of futures (with and without adaptation measures)
- Uses multiple climate projections as input to groundwater and surface water models
- ***Incorporates Input from Public Stakeholders***

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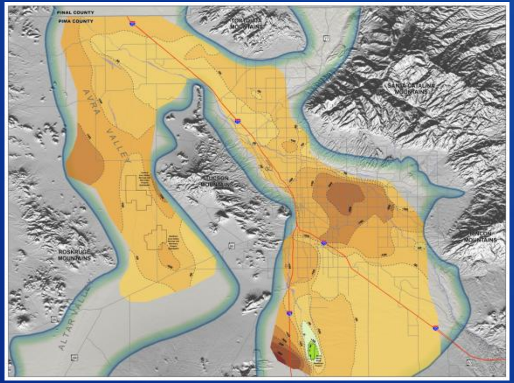
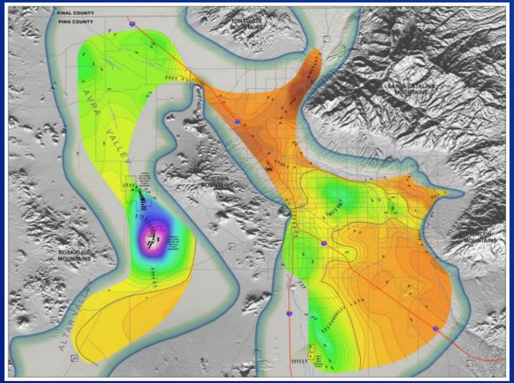
LSCR Basin Study Objectives

Tucson Basin Water Level Changes



1950 - 2000



2000 - 2014

1) Identify Where Physical Water Resources are Needed to Mitigate Supply-Demand Imbalances

2) Develop Adaptation Strategies to Improve Water Reliability for Municipal, Industrial, Agricultural and Environmental Sectors

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Cost-Share Partners

Southern Arizona Water Users Association

Arizona Department of Water Resources

Central Arizona Water Conservation District

Pima Association of Governments

Cortaro-Marana Irrigation District – Cortaro Water Users Association

The University of Arizona

Project Team

SAWUA

GVDWID

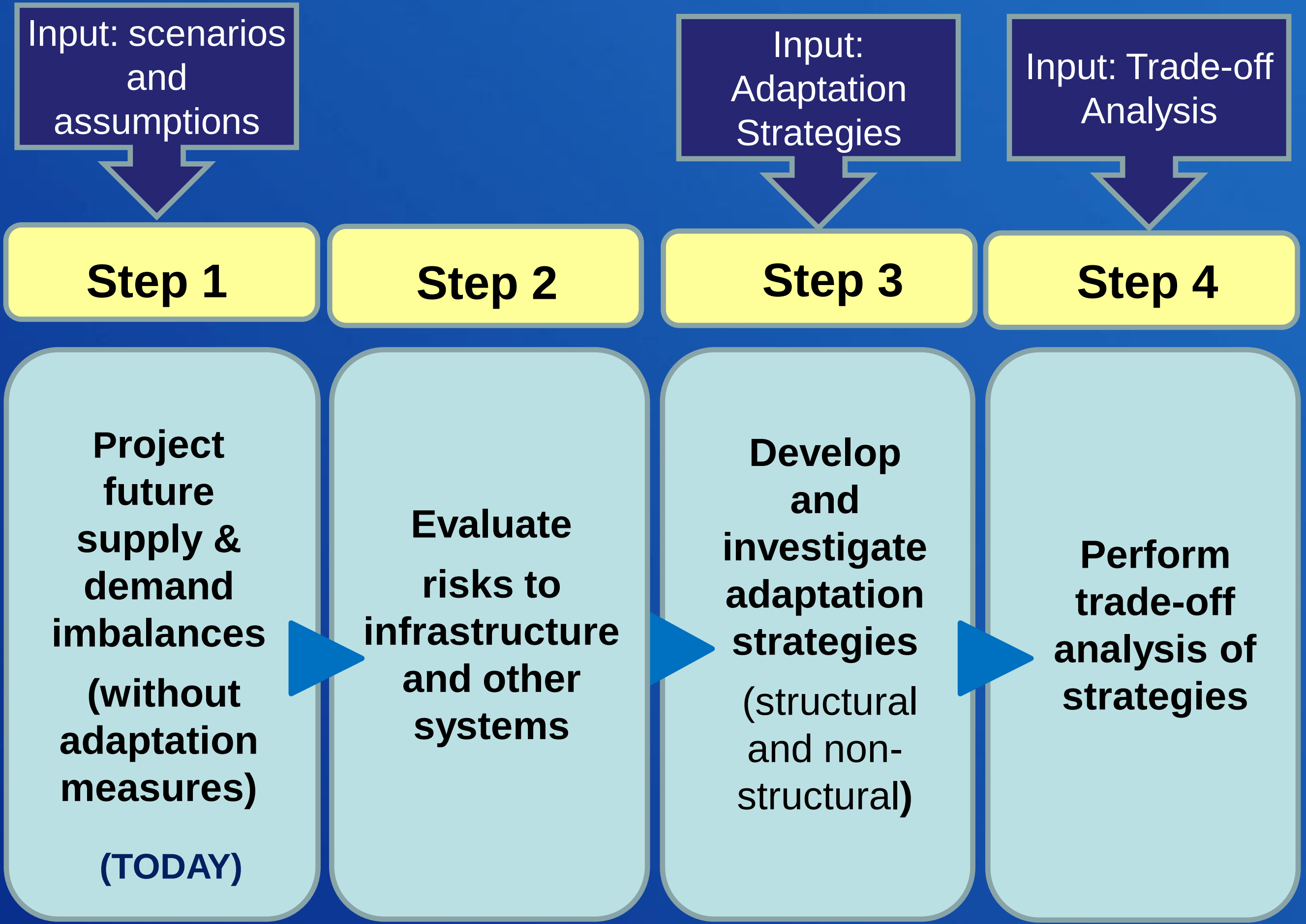
Kai Farms

Key Terms

- ***Risk* -** threats to life, health and safety, the environment, economic well-being, and other things of value
- ***Vulnerability* –** The degree to which physical, biological, and socio-economic systems are susceptible to and unable to cope with adverse impacts
- ***Adaptation* -** Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects

Source: U.S. Global Change Research Program, http://www.globalchange.gov/climate-change/glossary

Public Involvement: Key Part of Process



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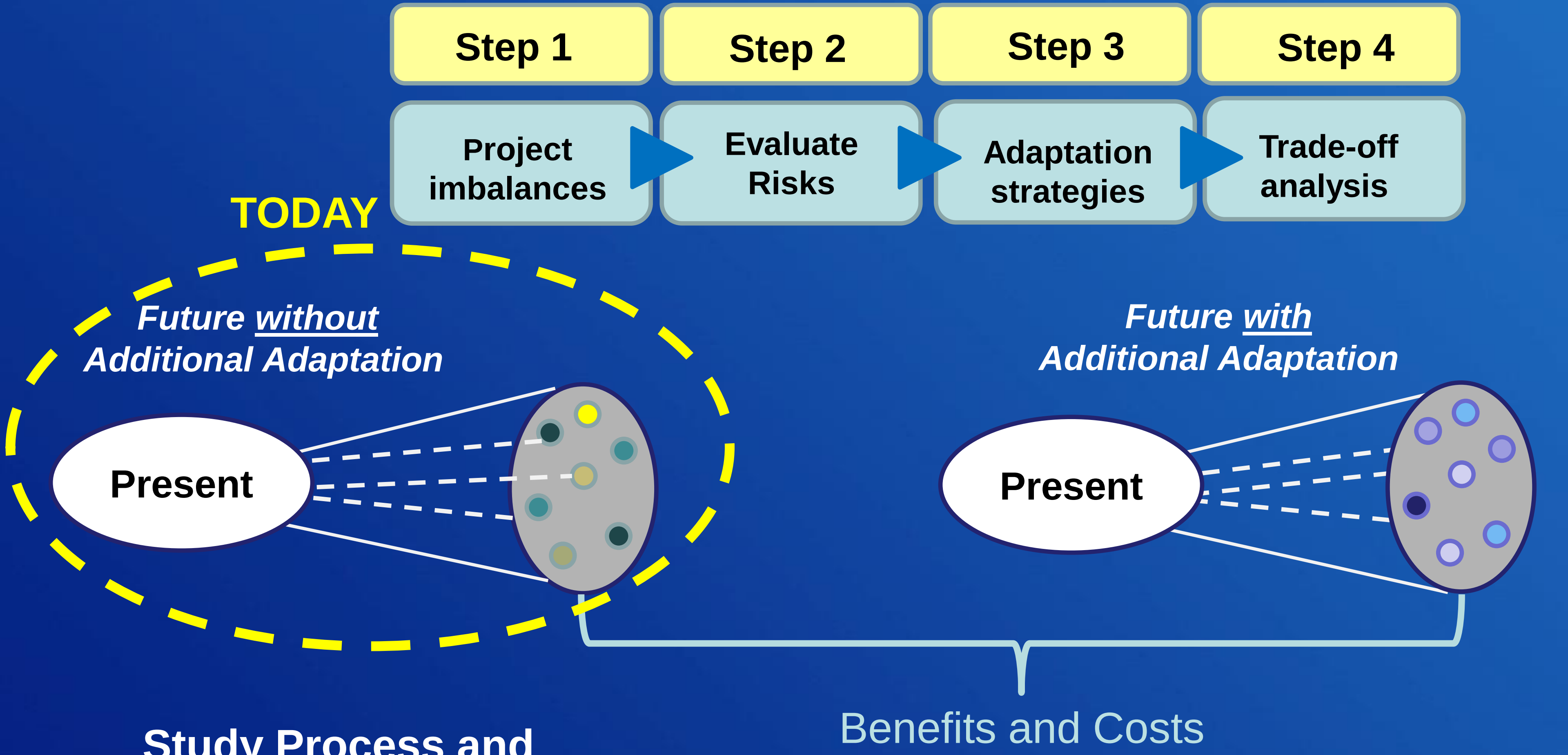

Study Process and Scenario Planning

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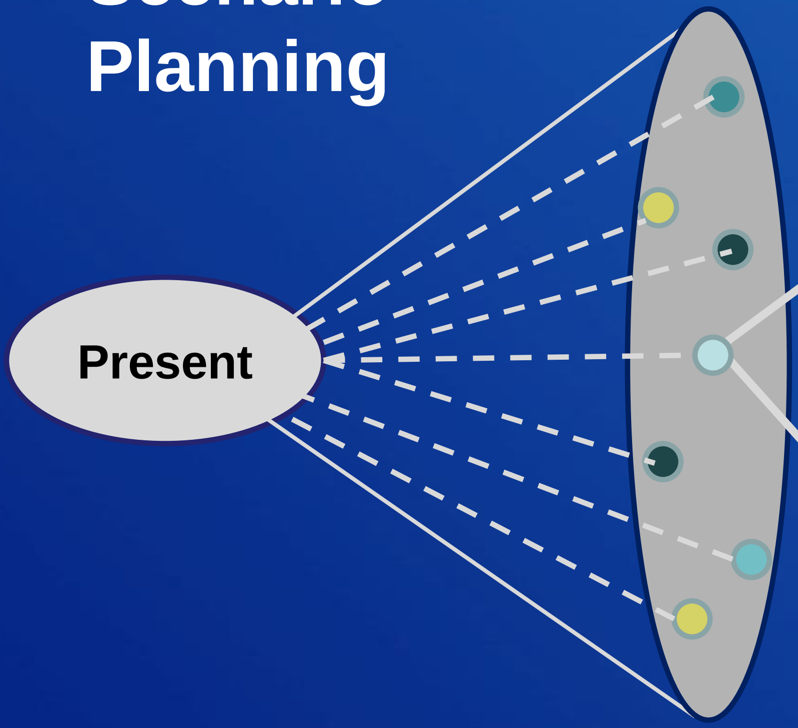
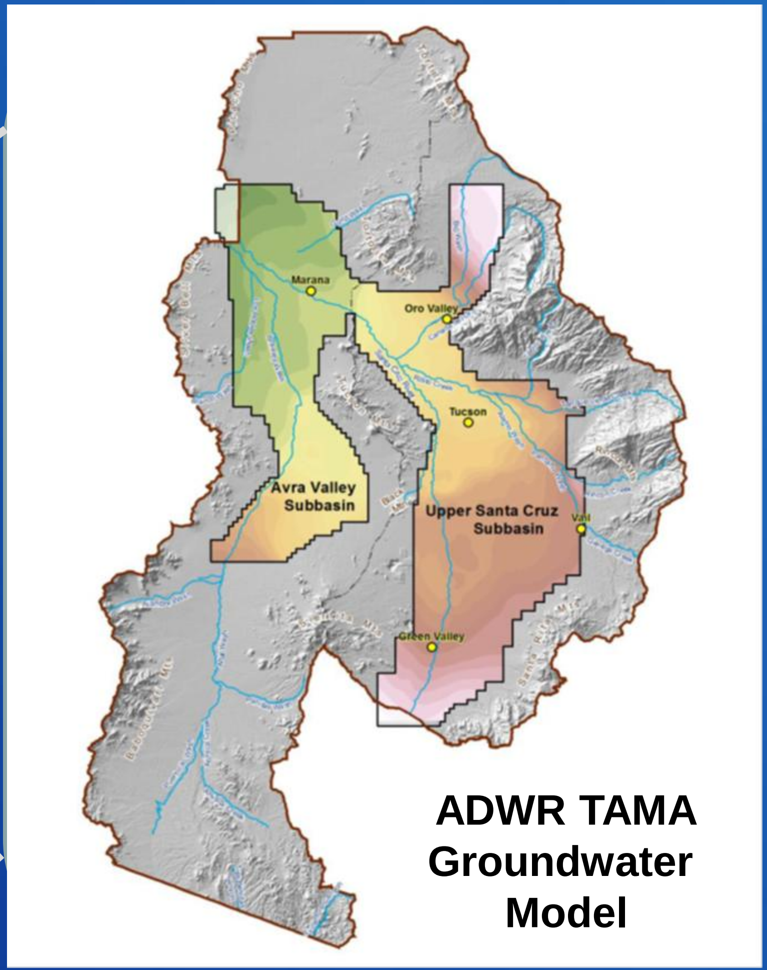
Scenario Planning





Scenarios: plausible futures, based on consistent assumptions

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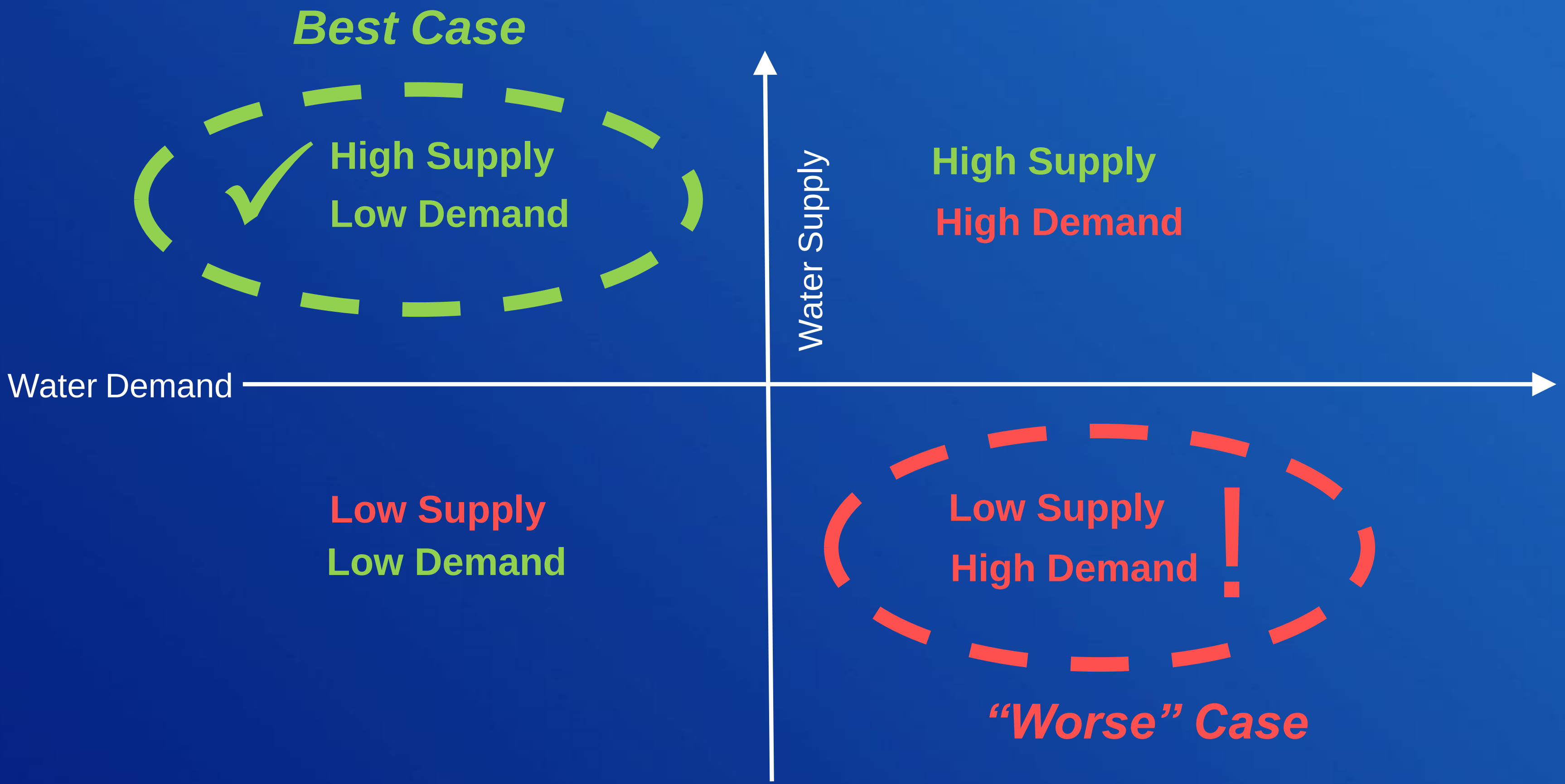
Potential Scenarios



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Scenarios Focus on Risk

"Base Case" (w/o Climate Change)	"Best Case"	"Worse Case"
Supply and Demand	Supply and Demand	Supply and Demand

Low Risk ⟷ High Risk

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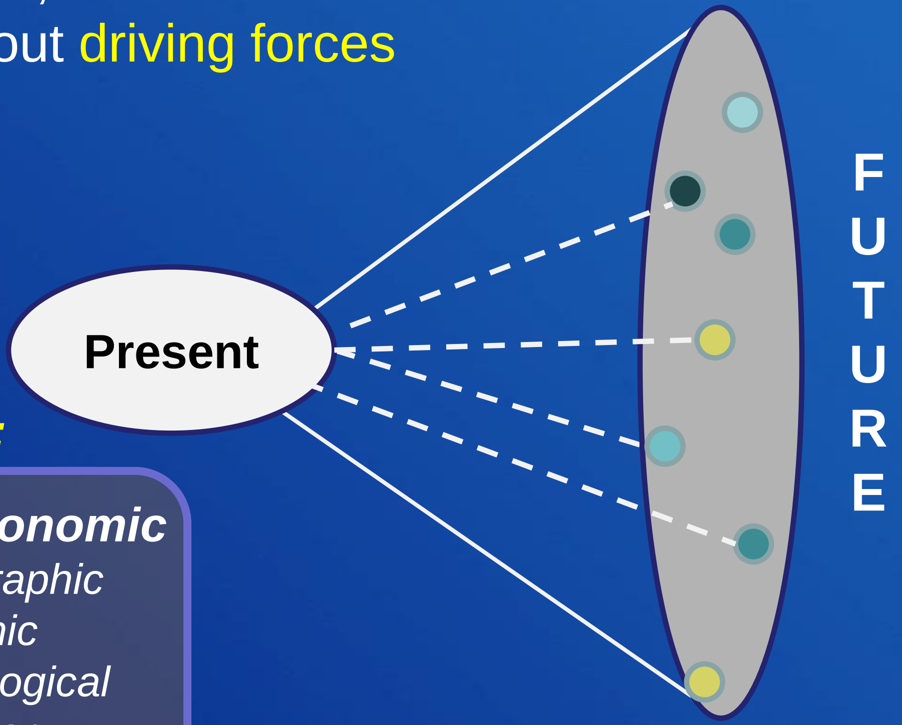
Scenario Planning

Scenarios: plausible futures, based on consistent assumptions about driving forces

Driving Forces:
Factors that will have the greatest influence on future conditions



Types of Driving Forces:

Climate
- *Temperature*
- *Precipitation*

Socio-Economic
- *Demographic*
- *Economic*
- *Technological*
- *Regulatory*

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Simplified Modeling Overview

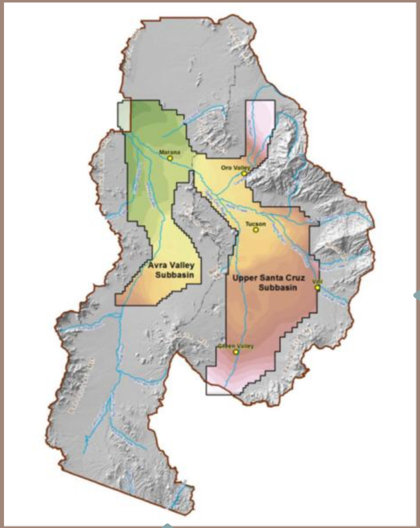
Tucson AMA Groundwater Model

Climate Driving Forces

(Precipitation, Temperature)

GLOBAL CLIMATE MODELS

SURFACE HYDROLOGY MODEL



Socio-Economic Driving Forces

(Demographics, Economics, Technological, Regulatory)

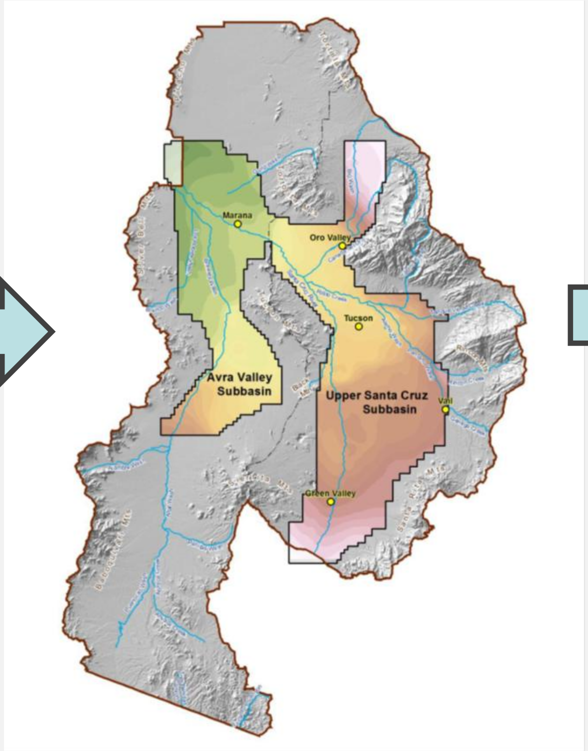
CAP SERVICE AREA MODEL

Groundwater Detail

Inflows

- Mountain Front Recharge
- Stream Infiltration
- Underflow from other basins
- Artificial Recharge (CAP and effluent)
- Agricultural Recharge
- Incidental Recharge

ADWR TAMA Groundwater Model



Outflows

- Pumping (Municipal, Industrial, Agricultural)
- Evapotranspiration by Riparian Areas
- Underflow to other basins

Drivers:

- Primarily Socio-Economic Forces
- Primarily Climate
- Estimated within Model

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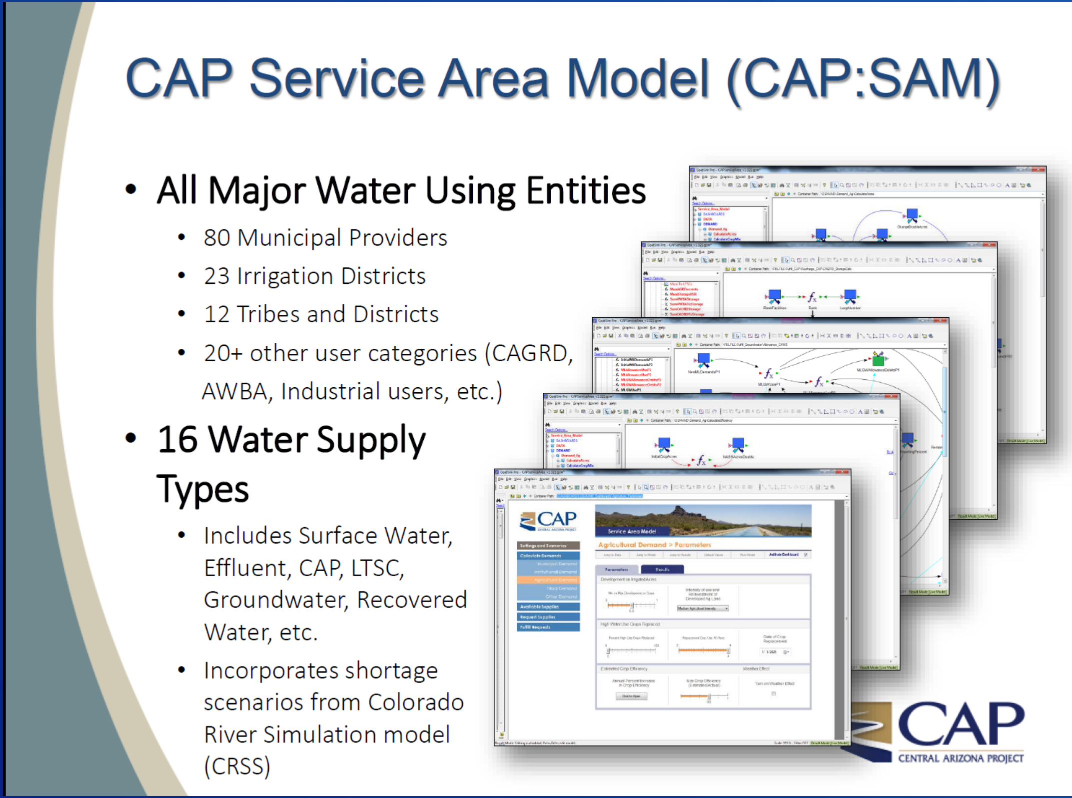
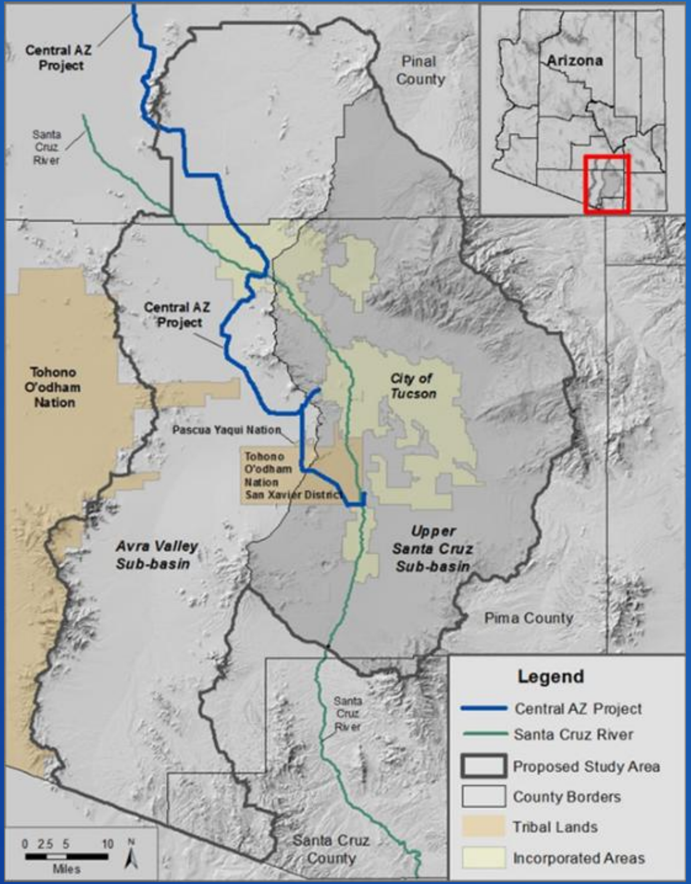
Socio-Economic Forces - CAP Service Area Model



- Models municipal, agricultural and industrial demands
- Demand estimated by water provider
- Matches each demand with supplies in order of preference

Introduction to Central Arizona Project Service Area Model (CAP-SAM)

Lower Santa Cruz River Basin Study



Ken Seasholes, Resource Planning & Analysis Manager,
Central Arizona Project

Stakeholder Advisors Meeting
April 24, 2017

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Introduction to CAP Service Area Model

- CAP:SAM is a tool for projecting supply & demand in Pima, Pinal and Maricopa Counties
- Accounts for complex legal and physical characteristics of users and supplies
- Designed to easily generate “what-if” scenarios

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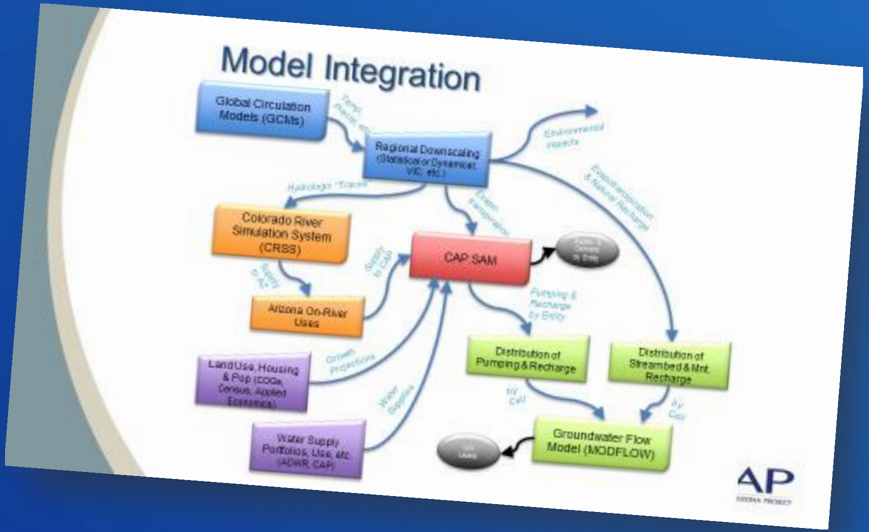
Introduction to CAP Service Area Model

- Like other computer models, CAP:SAM attempts to simulate aspects of the “real world” by representing key attributes of a complex system
  - Relationships
  - Parameters
  - Assumptions
  - Scenarios



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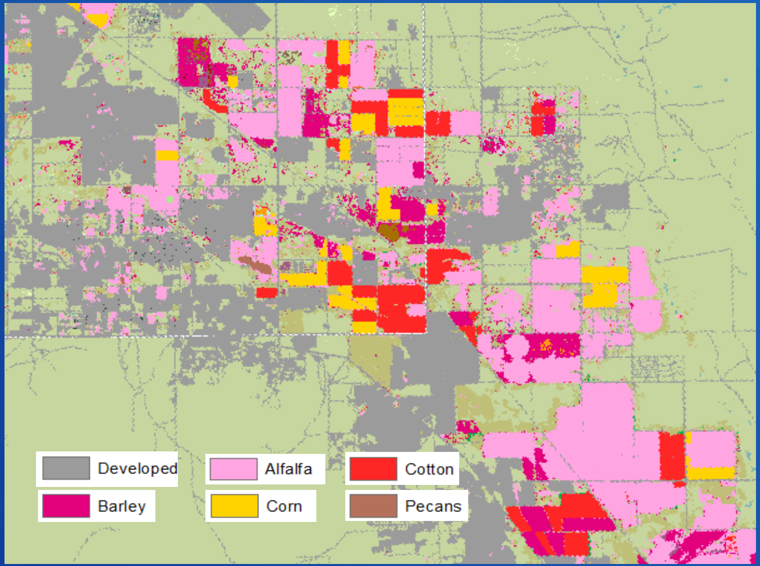
Introduction to CAP Service Area Model

- **Complex relationships among supply & demand factors**
  - Within demand (e.g., housing development on Ag land)
  - Within supply (e.g., use of long-term CAP contracts affects Excess CAP)
  - Between supply & demand (e.g., reductions in interior use affect effluent supplies)
- **Significant uncertainties across multiple dimensions**
  - The rate of growth
  - The location of growth
  - Changes in current and future demand factors
  - The use of different supply types
  - The reliability of those supplies

Introduction to CAP Service Area Model

- **Example: Agricultural demand is simulated as the relationship among the following parameters**
  - Acres in production
  - Crop types
  - Crop consumptive use
  - Irrigation efficiency
  - Climate factors
    - Effective precipitation
    - Heat stress

National Agricultural Statistics Service CropScape Data Layer, 2013



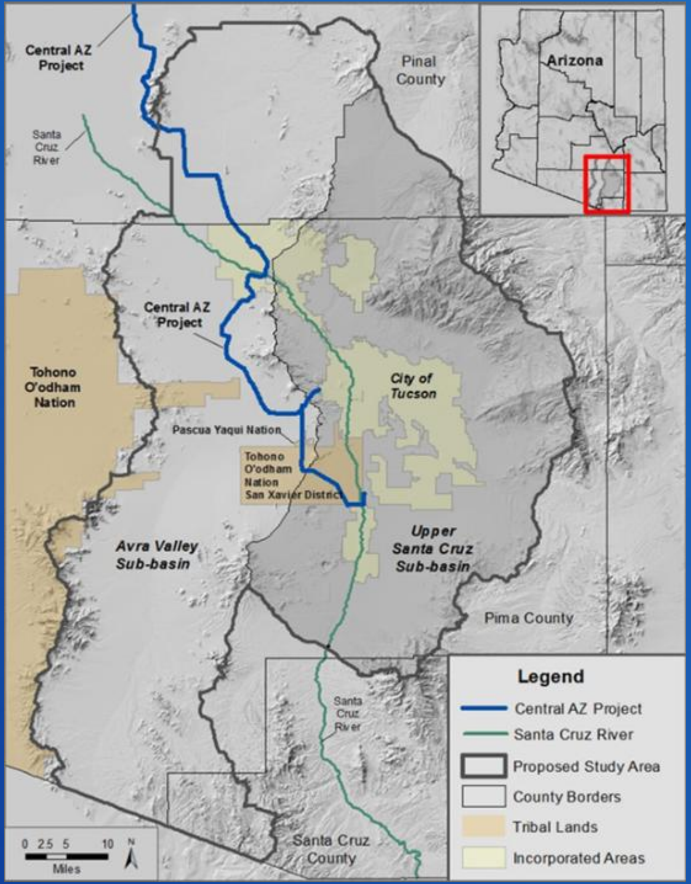
Introduction to CAP Service Area Model

- CAP:SAM allows the user to make assumptions about dozens of different parameters
- The model then performs a large number of calculations that estimate and track the results, based on the underlying relationships
- *As a tool, CAP:SAM is most useful when it is used to test and compare a range of possible future conditions (i.e., scenarios)*

Introduction to CAP Service Area Model

- Adjustable rate and spatial pattern of growth
- Variable rates of municipal use and conservation
- Projected agricultural demand, including changes in efficiency, crop types and consumptive use
- Calculated rate of urbanization of active Ag land
- Dynamic distribution of recharge activity
- Tracking of water supply portfolios, including leases, exchanges and long-term storage credits
- Linkage to Colorado River modeling
- Calculation of CAGRD replenishment obligation

Scenario Planning Demand Matrix for Stakeholder Advisors' Input



Lower Santa Cruz River Basin Study

Kathleen Chavez, Water Policy Manager, Pima County
Stakeholder Advisors Meeting
April 24, 2017

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Driving Forces of
Municipal, Agricultural, Industrial Water Demand in CAP-SAM

Municipal

- Population Growth Rate
- Location of Growth
- Growth Characteristics (Outward vs. Infill)
- Gallons per Housing Unit Per Day (GPHUD)

Agricultural

- Urbanization of Agricultural Land
- Crop Water Use

Industrial – Manufacturing

- Served by Municipal Water Provider or not

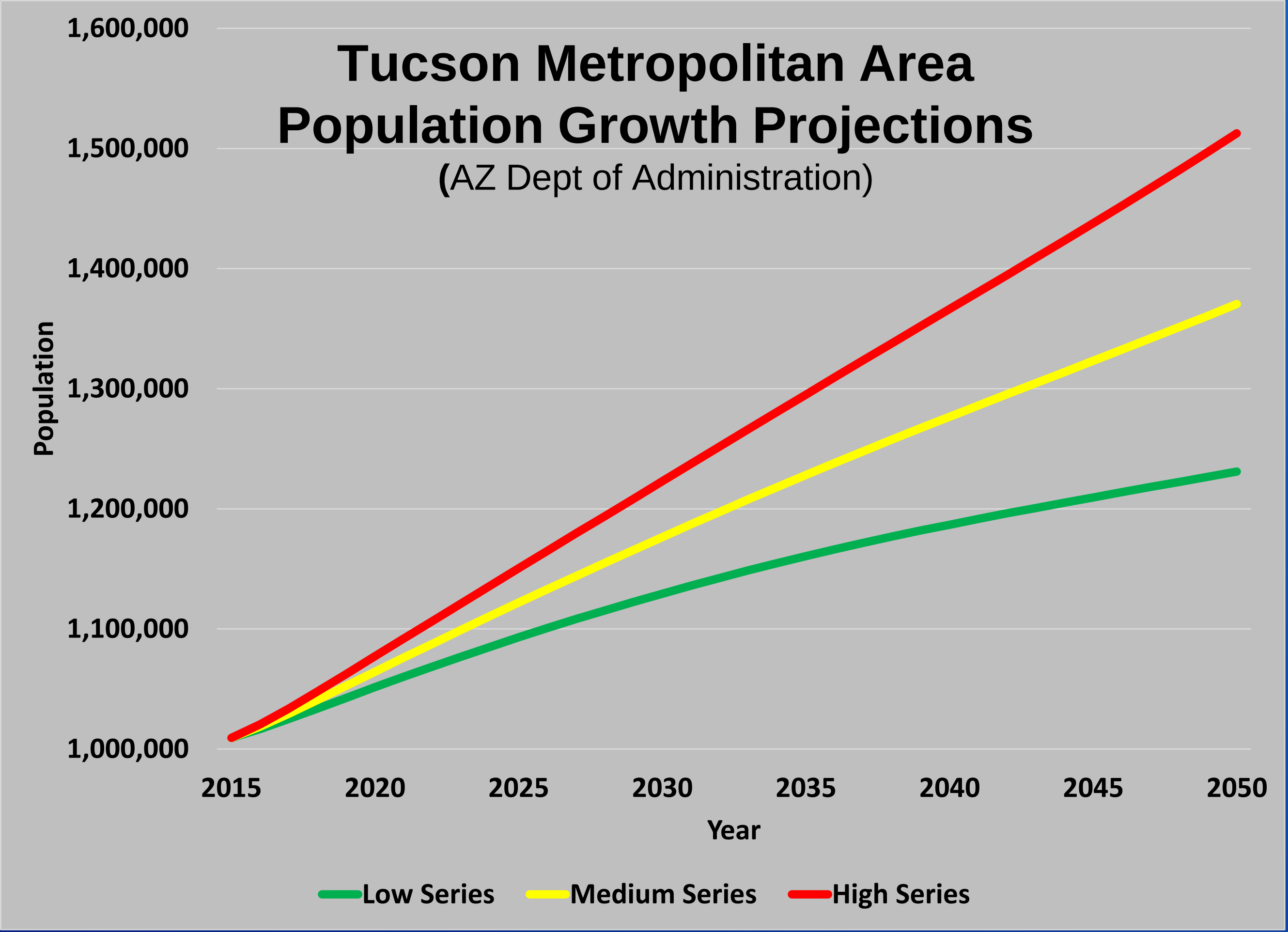
Industrial – Mining

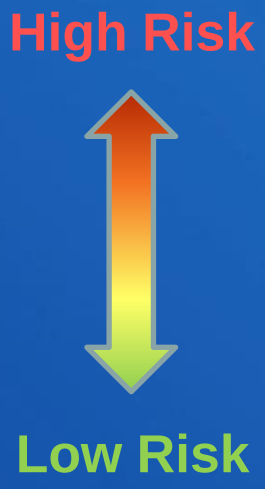
- Existing and Future Large Users

Example of Scenario Matrix Concept

Low Risk ⟷ High Risk

Driving Force	Demand Scenario 1	Demand Scenario 2	Demand Scenario 3	**Demand Scenario 4**	Demand Scenario 5
Municipal Demand Driving Forces					
a. Population Growth Rate					
b. Outward Growth vs. Infill					
c. Growth Density					
d. Gallons per Housing Unit per Day Water Use					





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Location of Growth

Infill Scenario: Slow & Compact

http://www.connect2edmonton.ca/showthread.php?21142-Raymond-Block-6-storeys-Mixed-Use-Proposed/page4

Outward Growth: Rapid & Outward

Credit: Jeff Dean (Source: Wikipedia)

Low Risk ⟷ **High Risk**

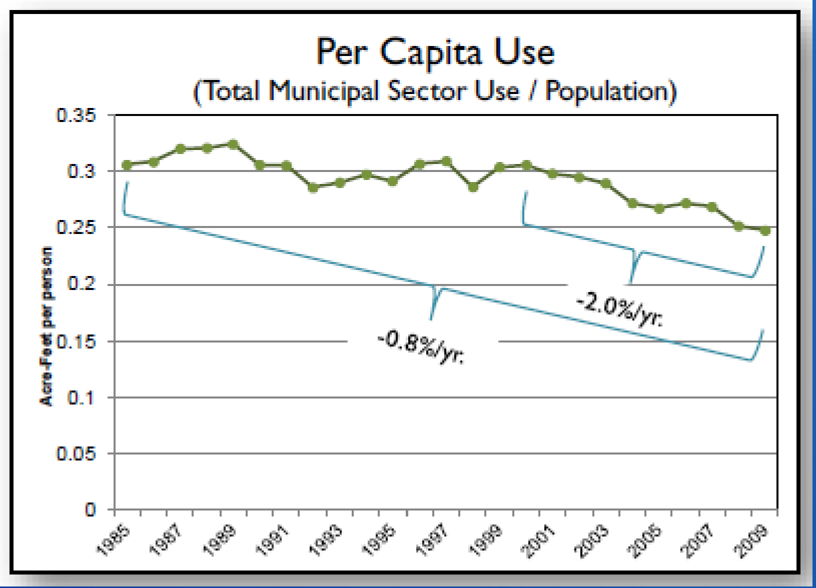
Water Demand

(gallons per housing unit per day)

High Risk

- Declines as Expected
- No Change
- Declines Faster than Expected

Low Risk



Agricultural Irrigation Demand
(consumptive water use of crop type)

Crop Type is Driven by Market Demand, mostly

https://toolkit.climate.gov/case-studies/managing-water-irrigated-agriculture-central-arizona-desert

High Risk

Low Risk

- Areas Convert to Higher Water Consumptive Use Crops
- No Change in Consumptive Use Crops
- Some Areas convert to Lower Water Consumptive Use Crops

Conversion of Agricultural Land to Residential Use

High Risk

Low Risk

- More development on undeveloped land before replacing agriculture
- Current trend
- Some areas convert to low water use residential developments

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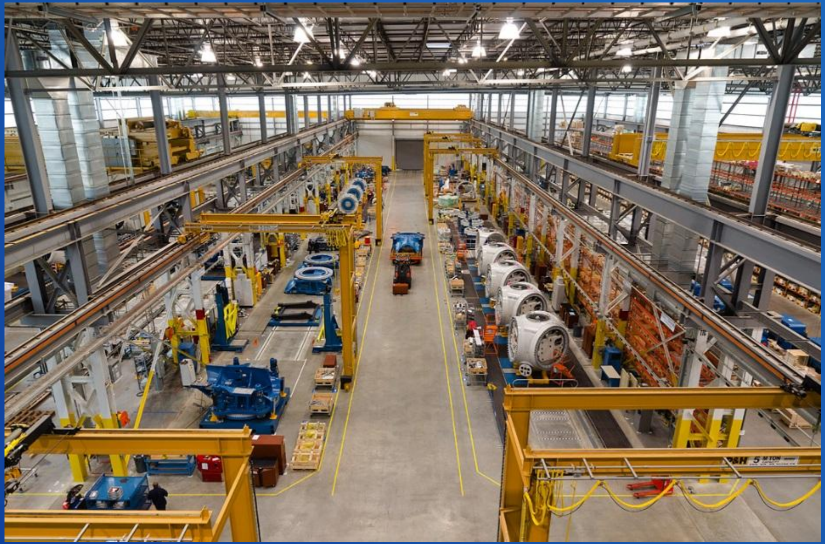
Industrial Demand - Manufacturing

High Risk

Low Risk

- Rapid Economic Growth that Depends on Groundwater/ Minimal Improvements in Water Efficiency
- Moderate Economic Growth
- Slow Economic Growth and/or Greatly Improved Water Use Efficiency



Credit: Energy.gov (Wikipedia)

Industrial Demand –Water for Mining

High Risk

Low Risk

Existing Mining

- More Mining
- Same Mining
- Less Mining

High Risk

Low Risk

Future Mining - Development and Timing

- Develops quickly
- Develops slowly
- Does not develop

https://pubs.usgs.gov/gip/deserts/minerals/

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Riparian Evapotranspiration

- Not directly measured as other types of demand
- Not modeled within CAP:SAM
- ADWR TAMA Groundwater Model estimates riparian ET at 8,000 acre-feet/year
- Riparian areas affected by temperature, available surface water and shallow groundwater
- Adaptation will include measures to support / enhance riparian areas

Credit: Pima County Office of Sustainability and Conservation

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Basin Study Next Steps

- Run Climate Projections through Hydrologic Models
- Select Best and Worse Case Climate / Hydrology Scenarios, including Stakeholder Input
- Combine Demand Scenarios with Selected Climate Projections, including Stakeholder input
- Run Supply and Demand Scenarios in through models
- Assess Risks to Reliability under each Scenario

Draft Demand Matrix (for input into CAP:SAM)

Driving Forces	Demand Scenario 1 Baseline	Demand Scenario 2 Slow Compact Growth	Demand Scenario 3 Slow Outward Growth	Demand Scenario 4 Rapid Outward Growth	Demand Scenario 5 Rapid Outward Growth Plus Mining & No Replenishment
Municipal Demand: Population Growth Rate	Medium	Low Series	Medium Series	High Series	High Series
Municipal Demand: Infill vs. Outward Growth	Baseline	In-Fill/Redevelopment	Slow Outward	Rapid Outward	Rapid Outward
Municipal Demand: Gallons Per Household Unit Per Day (GPHUD)	Decline as expected	Decline faster than expected	Decline as expected	No change in current GPHUD	No change in current GPHUD
Municipal Demand: Additional recharge	per current CAP-SAM assumptions	Year 2020	Year 2030	Year 2030	Never
Municipal Demand: Develop Ag Land or Undeveloped Land	Baseline	Low GPHUD development tends to replace high water use ag land.	CAP-SAM Baseline	Higher GPHUD development occurs on undeveloped land before replacing agriculture	Higher GPHUD development occurs on undeveloped land before replacing agriculture
Agricultural Demand: Consumptive Use (CU) Crop	Baseline	Some ag areas convert to low CU crops	No change in CU crops	Some ag areas convert to higher CU crops	Some ag areas convert to higher CU crops
Agricultural Demand: Groundwater Savings Projects	per current CAP-SAM assumptions	Highest savings start 2018	Highest savings start in 2018	Half of highest savings start in 2025	No savings
Industrial Demand: Manufacturing	Baseline	Slow economic growth and/or greatly improved water use efficiency	Moderate economic growth within existing water service areas, expected improvements in efficiency	Rapid economic growth that depends on groundwater, minimal improvements in efficiency	Rapid economic growth that depends on groundwater, minimal improvements in efficiency
Industrial Demand: Mining	Baseline	No new mines	New mine in 2020-2030	New mine in 2020-2030, Existing mines expand	New mine in 2020, Existing mines expand
Environment's Demand: Riparian Evapotranspiration	Baseline	Changes with climate and availability of surface water and shallow groundwater	Changes with climate and availability of surface water and shallow groundwater	Changes with climate and availability of surface water and shallow groundwater	Changes with climate and availability of surface water and shallow groundwater

What we are going to discuss today?

1. Have we represented the key driving forces affecting water demand?
2. Are the “building blocks” for the scenarios reasonable?
3. Are the scenario “building blocks” in logical groups?

GUIDED DISCUSSION OF DEMAND MATRIX

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